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(54) **Stapler device particularly useful in medical suturing**

Chirurgische Nähvorrichtung

Appareil pour effectuer des sutures en chirurgie

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Description

The present invention concerns a stapler device for fastening threaded staples to a bone according to the precharacterizing portion of claim 1.

The present invention relates to a stapler device, and particularly to a stapler device useful in medical suturing. The invention is especially useful in treating urinary stress incontinence, and is described below with respect to such an application, but it will be appreciated that the invention could advantageously be used in other applications as well, such as in treating a recurrent shoulder dislocation condition.

Urinary stress incontinence, i.e., the inability to control urination from the bladder, is a distressing problem for more than ten percent of elderly women as well as for many young women. This condition frequently arises in the following manner: In a normally anatomically positioned bladder, the proximal urethra and the bladder are in pressure continuity with the abdominal cavity, so that an increase in abdominal pressure is transmitted both to the bladder and to the proximal urethra, resulting in normal continence. However, particularly among elderly women, the bladder and the proximal urethra tend to descend from their normal anatomic positions such that the bladder neck and proximal urethra move away from the posterior wall of the pubic bone. When this occurs, the proximal urethra is no longer in pressure continuity with the abdominal cavity; therefore, an increase in intra-abdominal pressure (e.g., by laughing or coughing) results in an increase in the intravesical pressure, but no change in the urethral closing pressure, thereby producing stress incontinence. It also appears that as the bladder descends, the urethra becomes shorter and curved, so that its radial tonic muscle contraction is reduced, contributing to incontinence.

Many treatments have been devised to correct stress incontinence. One treatment is by a surgical operation, involving an incision in the abdominal wall and/or interior vaginal wall, to return the bladder and proximal urethra to their normal anatomic positions by elevating them towards the posterior wall of the pubic bone in order to bring them into pressure continuity with the abdominal cavity. Another medical treatment involves a closed operation in which the bladder neck is elevated by suture threads passing, with the aid of long needles, from both sides of the urethra in the bladder neck to the inferior abdominal wall.

The US-A-4 527 726 discloses a bone stapler for driving staples to join adjacent bone portions comprising a handle, a drive means, a trigger and a passageway adapted to guide staplers.

An object of the present invention is to provide a stapler device which is particularly useful for fastening threaded staples to a bone for various medical purposes, particularly to treat urinary stress incontinence in the latter type of closed operation.

According to the present invention there is provided a stapler device for fastening threaded staples to a bone, comprising: a handle manually grippable by a user containing a drive mechanism and a trigger to activate the drive mechanism; said drive mechanism generating a driving force into a bone, said force being sufficient to completely implant the staple into the bone and under the surface of the bone without predrilling a hole in the bone; a barrel fixed to the handle; a staple guide for holding a staple to be ejected, and an ejector pin driven by the drive mechanism, movable in said barrel for ejecting said staple out through an end of the staple guide; characterized in that said end of the staple guide is formed with a recess on its inner surface for receiving a suture thread fixed to the staple.

Such a stapler device is particularly useful for treating women suffering from urinary stress incontinence caused by the descending of the bladder and the proximal urethra from their normal anatomical positions. Thus, the staple may be ejected through the vaginal wall to enter the pubic bone, and the suture thread secured to the staple may be used for attaching the bladder neck and the proximal urethra to the posterior wall of the pubic bone. Such a stapler device may also be used in other applications, for example in medical operations for the fixation of a shoulder capsule in a person suffering from chronic shoulder dislocation.

The staples which may be used for ejection by the above-described stapler device according to the present invention include a suture thread secured thereto.

Further features and advantages of the invention will be apparent from the description below.

The invention is herein described, by way of example only, with reference to the accompanying drawings, wherein:

Fig. 1 illustrates one form of stapler device constructed in accordance with the present invention;
Figs. 2 and 3 illustrate the natural curved shape and the temporary straight shape respectively, of one form of staple with attached thread which may be used with the present invention;
Fig. 4 is an enlarged sectional view of the staple guide in the stapler device of Fig. 1;
Fig. 5a is an end view illustrating the staple guide of Fig. 4; Fig. 5b is similar to Fig. 5a, illustrating a modification in the construction of the staple guide;
Figs. 6 and 7a, 7b are views similar to Figs. 4 and 5a, 5b respectively, illustrating a modification in the construction of the staple guide;
Figs. 8a-8e illustrate various stages in applying the staple and thread of Figs. 2 and 3 to the pubic bone when treating for urinary stress incontinence (or other bone when treating for other conditions).
Figs. 9-11 illustrate modifications in the construction of the stapler device of Fig. 1;
and Figs. 12-18 illustrate other forms of staple-thread units which may be used.

The stapler device illustrated in Fig. 1 comprises a

housing, generally designated 2, including a handle 4 which is manually grippable by the user. The illustrated stapler device is pneumatically powered and therefore includes a connector 6 at the bottom of the handle 4 for attaching thereto a tube 8 connectible to a source of pressurized air. Housing 2 further includes an elongated barrel 10 having a staple guide 12 at its end for the staple 14 to be ejected. Ejection of the staple 14 is effected by an ejector pin 16 which is driven into sharp impact against the base of the staple 14 by the air pressure supplied from the pressurized air tube 8. Handle 4 includes a trigger 18 which, when depressed, applies an air pressure pulse to ejector pin 16 to cause it to impact against the base of staple 14 and thereby to eject the staple out through the end of guide 12. Insofar as described, such staple devices are known, and therefore further details of its construction and operation are not set forth.

As distinguished from the known constructions, the staple 14 ejected from the guide 12 at the end of barrel 10 in Fig. 1 has a suture thread 20 secured to the staple and ejected with it. In the above-described application, the staple is driven into the patient's pubic bone, and the thread 20 may then be used for fixing the bladder neck and proximal urethra thereto.

The staple 14 in Fig. 1 is made of elastic material. The staple is preferably shaped into the curved form illustrated at 14' in Fig. 2 while it is in its normal condition, and is deformed into the straight form shown at 14" in Fig. 3 while in a straight condition. It is loaded into the stapler and ejected therefrom while in its straight stressed condition. After it has been so ejected, it returns to its curved form shown at 14' in Fig. 2, thereby better fixing the staple to the bone tissue it penetrated when ejected from the staple guide 12.

As shown in Figs. 2 and 3, the staple 14 is formed with a pointed end 14a to enable it to penetrate the bone, and with a hole 14b approximately midway of its length for receiving the thread 20, similar to the manner in which a thread is received in the eye of a needle.

Figs. 4 and 5 more particularly illustrate the staple guide 12 from which the staple 14, including its attached thread 20, is ejected. As shown, this guide is formed with a pair of slots 22 to accommodate the thread 20. Thus, when the base 14c of staple 14 is impacted by the ejector pin 16, the thread 20 moves through slot 22, thereby permitting the staple guide 12 to snugly fit around the ejected staple 14.

Figs. 6 and 7 illustrate a modification in the construction of the staple guide 12 in order to accommodate the thread 20 secured to the staple 14. In the modification of Figs. 6 and 7, the inner surface of the staple guide 12 is formed with a pair of recesses 22a for receiving the two sides of the thread 20.

The manner of using the illustrated stapler device will now be described particularly with reference to Figs. 8a-8e.

Thus, the staple 14, together with its attached thread 20, is loaded into the staple guide 12 while the staple is in its straight condition as illustrated at 14" in Fig. 3. Depressing trigger 18 causes a high-pressure pulse of air to be applied to ejector pin 16. This pulse causes ejector pin 16 to impact against the end face 14c of the staple 14, thereby driving the staple into the bone as shown in Figs. 8a and 8b. As soon as the staple penetrates the bone, it starts to return to its normal, curved shape as shown in Figs. 8c and 8d. The staple is thus firmly anchored to the bone with its attached thread 20 extending through the opening formed by the staple through the bone, as shown in Fig. 8e.

Following is one procedure for performing the above-described operation: A 20F urethral catheter is inserted into the bladder, and a balloon is inflated to 20 cc and retracted gently downwardly against the bladder neck. The surgeon inserts two fingers into the vagina, pressing the interior vaginal wall with one finger on each side of the urethra, which is felt because of the inserted catheter. By pressing the fingers upwardly and backwardly, the bladder neck and proximal urethra are pressed against the posterior wall of the pubic bone. At this stage, two staples are ejected longitudinally on each side of the urethra, about 1-2 cm apart. The two threads on each side of the urethra are tied one to the other. They may be tied on the vaginal mucosa, in which case the tension will embed the threads to the sub-mucosa after some time. Alternatively, the threads may be tied under the vaginal mucosa by passing one of the threads on the same side. The threads may be made of a monofilament non-absorbent material, as well as of an absorbent material, dependent on the preference of the physician.

In cases where the urethra itself is very wide, the threads may be used for engaging and elevating the urethra to the posterior pubic bone as in a "sling operation".

The stapler barrel 10 in Fig. 1 is preferably of a flexible plastic tube. Fig. 9 illustrates a variation wherein the stapler barrel is in the form of a closed helical wire 110 enclosed within a thin flexible tube 111, which increases the flexibility of the barrel and thereby facilitates its placement at the proper direction. Fig. 10 illustrates a variation wherein the barrel, therein designated 210, is a stiff or rigid tube.

Fig. 11 illustrates a further variation wherein the stapler, therein designated 302, includes two barrels 310a, 310b in parallel relation to each other to enable two staples with attached threads to be ejected at the same time. In the modification illustrated in Fig. 11, each of the staple guides 312a, 312b receives a staple-thread unit 314a, 314b ejected by an ejector pin 316a, 316b received in the respective barrel, and both ejector pins are driven at the same time by high pressure pulses produced upon depression of the trigger 318.

Figs. 12-18 illustrate other constructions of staple-thread units which may be used.

The unit illustrated in Fig. 12 includes a staple 114 and a thread 120 similar to the construction illustrated in Figs. 2 and 3, except that the hole 114b through which

the thread 120 is passed is at the rear end of the staple, rather than at the middle.

Fig. 13 illustrates a construction wherein the staple 214 is provided with a bore 214b extending at an angle to the longitudinal axis of the staple 214 with the end of the thread 220 received and fixed therein by crimping the staple. Fig. 14 illustrates a construction wherein the bore 314b is in the base 314c of staple 314 and extends along or parallel to the longitudinal axis of the staple 314, the thread 320 being received within the bore 314b and fixed therein by crimping the staple. Fig. 15 illustrates a construction similar to that of Fig. 14, except that part of the base 414c of the staple 414, formed with the axial bore 414b for receiving the thread 420, is cut away so that the impact of the ejector pin against the base of the staple will not impact against the end of the thread.

Fig. 16 illustrates a further variation wherein the staple 514 is formed with a plurality of barbs 515 projecting from its outer surface, to fix the staple to the bone which it penetrates. The thread 520 is passed through a hole 514b in the staple.

Fig. 17 illustrates a staple made of bent wire. Fig. 18 illustrates a staple with a split tail 714c, which is straightened when inserted into the staple guide 12.

While the invention has been described with respect to one particular application, it will be appreciated that the described stapler device and stapler-thread units may be used for other applications, e.g., for shoulder dislocations, endoscopic operations, or the like. The stapler may also be electrically operated and may use other mechanical impact devices for driving the stapler. The staples themselves may be of known bioabsorbable materials.

Claims

1. A stapler device for fastening threaded staples to a bone, comprising: a handle (4) manually grippable by a user containing a drive mechanism and a trigger (18) to activate the drive mechanism; said drive mechanism generating a drive force for a staple into a bone, a barrel (10) fixed to the handle (4); a staple guide (12) for holding a staple (14) to be ejected, and an ejector pin (16) driven by the drive mechanism, movable in said barrel (10) for ejecting said staple (14) out through an end of the staple guide (12); characterized in that said drive force is sufficient to completely implant the staple (14) into the bone and under the surface of the bone without predrilling a hole in the bone; and said end of the staple guide (12) is formed with a recess (22a) on its inner surface for receiving a suture thread (20) fixed to the staple (14).

2. The stapler device according to claim 1, wherein said drive mechanism is a pneumatic drive, and said handle (4) includes a connector (6) for connecting thereto an air tube (8) supplying pressurized air to the device.

3. The stapler device according to claim 1 characterized in that the internal surface of said end of the staple guide (12) is formed with two recesses (22a) on opposite sides thereof each dimensioned to receive a section of the suture thread (20) fixed to the staple (14) and ejected therewith.

4. The stapler device according to any one of claims 1-3, characterized in that the device includes two barrels (310a, 310b) and two staple guides (312a, 312b) in parallel relation to each other and fixed to a common handle (304), each of said barrels (310a, 310b) including an ejector pin (316a, 316b) for ejecting a staple (314a, 314b) from its respective staple guide (312a, 312b), said handle (304) including a drive for driving both said ejector pins (316a, 316b).

5. The stapler device according to claim 1 characterized in that said barrel (10) is flexible.

6. The stapler device according to claim 1, characterized in that said recess (22a) comprises an axially extending slot (22).

7. The stapler device according to claim 1, characterized in that said recess (22a) comprises a pair of opposed axially extending slots for receiving a section of the suture thread (20).

8. The stapler device according to claim 1, characterized in that said recess (22a) extends to the outside surface of said barrel.

9. The stapler device according to claim 4, characterized in that said ejector pins (316a, 316b) are activated by a single trigger (318).

10. The stapler device according to claim 4, characterized in that said single trigger (318) activates both of said ejector pins (316a, 316b) simultaneously.

11. A device consisting of a stapler device according to any one of the claims 1-10 in combination with a staple (14) including a suture thread (20) secured thereto.

12. The device according to claim 11, characterized in that said staple (14) is formed from an elastic material which changes shape when no longer held by said staple guide (12).

13. The device according to claim 11, characterized in that the staple (14) has a leading tip and a driven end for receiving implanting force to implant said staple (14) into the bone of a patient, said staple (14) having a longitudinal axis which passes

through said tip and said driven end, said longitudinal axis changing shape upon implantation of said staple (14) into a bone.

14. The device according to claim 11 characterized in that said suture thread (20) is attached through a hole (14b) in said staple (14).

15. The device according to claim 14, characterized in that said hole (14b) is located between said tip and said driven end.

16. The device as to claim 13, characterized in that said staple (514) further comprises barbs (515)which project outwardly from said driven end when said staple is ejected into the bone.

17. The device according to claim 13, characterized in further comprising a crimped bore in said staple (14) which frictionally holds said suture thread (20) during implantation of said staple (14) into the bone.

18. The device according to claim 17, characterized in that said crimped bore extends at an angle to said longitudinal axis.

19. The device according to claim 13, characterized in that said driven end of said staple (14) is substantially flat prior to implantation into the bone.

20. The device according to claim 13, characterized in that said staple is formed from wire bent into a U-shape with said suture thread held in the bight of the staple.

21. The device according to claim 13, characterized in that said staple is initially substantially flat and upon implantation into a patient's bone changes to a shape having a split tail-like driven end.

22. The device according to claim 13 wherein the staple (14) is formed with a throughgoing hole (14b) and said suture thread (20) is secured to the staple (14) by being passed through said hole (14b).

23. The device according to claim 13, wherein said staple (14) is made of an elastic material and is formed with a curved shape, is temporarily deformed into a straight shape at the time it is ejected, and returns to its curved shape after ejection.

24. The device according to claim 13, wherein the staple (514) is formed with a plurality of barbs (515)projecting from its outer surface.

25. The device according to claim 13 characterized in that said ejector pin (16) has a front end for contact with the staple (14) and said ejector pin (16) contacts the staple without said front end coming into contact with the suture thread (20).

Patentansprüche

1. Klammervorrichtung, um eingefädelte Klammern an einem Knochen zu befestigen, die umfasst: einen Griff (4), der durch einen Benutzer von Hand ergriffen werden kann und der eine Antriebsvorrichtung und einen Auslöser (18) hat, um die Antriebsvorrichtung zu betätigen; wobei die Antriebsvorrichtung eine Antriebskraft für eine Klammer in einen Knochen hinein erzeugt, ein Rohr (10), das am Griff (4) befestigt ist; eine Klammerführung (12), um eine Klammer (14), die ausgeworfen werden soll, zu halten, und einen Auswurfstift (16), der durch die Antriebsvorrichtung angetrieben wird und im Rohr (10) bewegt werden kann, um die Klammer (14) durch ein Ende der Klammerführung (12) hindurch auszuwerfen; dadurch gekennzeichnet, dass die Antriebskraft ausreichend ist, um die Klammer (14) vollständig in den Knochen hinein und unter die Oberfläche des Knochens zu implantieren, ohne ein Loch in den Knochen vorzubohren; und dass das Ende der Klammerführung (12) mit einer Aushöhlung (22a) auf ihrer Innenseite ausgebildet ist, um einen Nähfaden (20) aufzunehmen, der an der Klammer (14) befestigt ist.

2. Klammervorrichtung nach Anspruch 1, bei der die Antriebsvorrichtung aus einem pneumatischen Antrieb besteht und der Griff (4) einen Anschluss (6) umfasst, um daran einen Luftschlauch (8) anzuschliessen, der Druckluft an die Vorrichtung liefert.

3. Klammervorrichtung nach Anspruch 1, dadurch gekennzeichnet, dass die Innenseite des Endes der Klammerführung (12) mit zwei Aushöhlungen (22a) auf gegenüberliegenden Seiten von ihr ausgebildet ist, die beide so bemessen sind, dass sie einen Abschnitt des Nähfadens (20) aufnehmen können, der an der Klammer (14) befestigt ist und mit ihr ausgeworfen wird.

4. Klammervorrichtung nach irgend einem der Ansprüche 1-3, dadurch gekennzeichnet, dass die Vorrichtung zwei Rohre (310a, 310b) und zwei Klammerführungen (312a, 312b) in paralleler Anordnung zueinander und an einem gemeinsamen Griff (304) befestigt umfasst, wobei jedes der Rohre (310a, 310b) einen Auswurfstift (316a, 316b) umfasst, um eine Klammer (314a, 314b) von ihrer entsprechenden Klammerführung (312a, 312b) auszuwerfen, wobei der Griff (304) einen Antrieb umfasst, um beide Auswurfstifte (316a, 316b) anzutreiben.

5. Klammervorrichtung nach Anspruch 1, dadurch gekennzeichnet, dass das Rohr (10) flexibel ist.

6. Klammervorrichtung nach Anspruch 1, dadurch gekennzeichnet, dass die Aushöhlung (22a) einen axial verlaufenden Schlitz (22) umfasst.

7. Klammervorrichtung nach Anspruch 1, dadurch gekennzeichnet, dass die Aushöhlung (22a) ein Paar von gegenüberliegenden, axial verlaufenden Schlitzen umfasst, um einen Abschnitt des Nähfadens (20) aufzunehmen.

8. Klammervorrichtung nach Anspruch 1, dadurch gekennzeichnet, dass die Aushöhlung (22a) sich bis zur Aussenseite des Rohres erstreckt.

9. Klammervorrichtung nach Anspruch 4, dadurch gekennzeichnet, dass die Auswurfstifte (316a, 316b) durch Einen einzigen Auslöser (318) betätigt werden.

10. Klammervorrichtung nach Anspruch 4, dadurch gekennzeichnet, dass der einzige Auslöser (318) die beiden Auswurfstifte (316a, 316b) gleichzeitig betätigt.

11. Vorrichtung, die aus einer Klammervorrichtung nach irgend einem der Ansprüche 1-10 besteht, in Kombination mit einer Klammer (14), die einen Nähfaden (20) umfasst, der daran befestigt ist.

12. Vorrichtung nach Anspruch 11, dadurch gekennzeichnet, dass die Klammer (14) aus einem elastischen Material gebildet ist, welches die Form ändert, sobald es nicht mehr durch die Klammerführung (12) festgehalten wird.

13. Vorrichtung nach Anspruch 11, dadurch gekennzeichnet, dass die Klammer (14) eine vordere Spitze und ein angetriebenes Ende zur Aufnahme der implantierenden Kraft hat, um die Klammer (14) in den Knochen eines Patienten hinein zu implantieren, wobei die Klammer (14) eine Längsachse hat, welche durch die Spitze und das angetriebene Ende hindurch verläuft, wobei die Längsachse nach der Implantation der Klammer (14) in einem Knochen die Form ändert.

14. Vorrichtung nach Anspruch 11, dadurch gekennzeichnet, dass der Nähfaden (20) durch ein Loch (14b) hindurch in der Klammer (14) befestigt ist.

15. Vorrichtung nach Anspruch 14, dadurch gekennzeichnet, dass das Loch (14b) zwischen der Spitze und dem angetriebenen Ende angeordnet ist.

16. Vorrichtung nach Anspruch 13, dadurch gekennzeichnet, dass die Klammer (514) weiter Widerhaken (515) umfasst, welche vom angetriebenen Ende nach aussen vorstehen, wenn die Klammer in den Knochen hinein ausgeworfen ist.

17. Vorrichtung nach Anspruch 13, dadurch gekennzeichnet, dass sie weiter eine Crimp-Bohrung in der Klammer (14) umfasst, welche den Nähfaden (20) während der Implantation der Klammer (14) im Knochen reibschlüssig festhält.

18. Vorrichtung nach Anspruch 17, dadurch gekennzeichnet, dass die Crimp-Bohrung unter einem Winkel zur Längsachse verläuft.

19. Vorrichtung nach Anspruch 13, dadurch gekennzeichnet, dass das angetriebene Ende der Klammer (14) vor der Implantation im Knochen im wesentlichen flach ist.

20. Vorrichtung nach Anspruch 13, dadurch gekennzeichnet, dass die Klammer aus einem Draht gebildet ist, der in eine U-Form gebogen ist, wobei der Nähfaden in der Krümmung der Klammer festgehalten wird.

21. Vorrichtung nach Anspruch 13, dadurch gekennzeichnet, dass die Klammer ursprünglich im wesentlichen flach ist und sich nach der Implantation in einem Knochen eines Patienten zu einer Form verändert, die ein gespaltenes, schwanzförmiges, angetriebenes Ende hat.

22. Vorrichtung nach Anspruch 13, bei der die Klammer (14) mit einem durchgehenden Loch (14b) ausgebildet ist und der Nähfaden (20) an der Klammer (14) befestigt ist, indem er durch das Loch (14b) hindurch geführt ist.

23. Vorrichtung nach Anspruch 13, bei der die Klammer (14) aus einem elastischen Material hergestellt ist und mit einer gekrümmten Form gebildet ist, wobei sie vorübergehend zur Zeit, wenn sie ausgeworfen wird, in eine gerade Form deformiert wird und nach dem Auswerfen in ihre gekrümmte Form zurückkehrt.

24. Vorrichtung nach Anspruch 13, bei der die Klammer (514) mit einer Vielzahl von Widerhaken (515) ausgebildet ist, welche von ihrer Aussenseite vorstehen.

25. Vorrichtung nach Anspruch 13, dadurch gekennzeichnet, dass der Auswurfstift (16) ein vorderes Ende für die Berührung der Klammer (14) hat und dass der Auswurfstift (16) die Klammer berührt, ohne dass das vordere Ende den Nähfaden (20) berührt.

Revendications

1. Un dispositif d'agrafage pour fixer des agrafes pourvues d'un fil à un os, comprenant: une poignée (4) pouvant être saisie manuellement par un utilisateur,

contenant un mécanisme de commande et une gâchette (18) pour actionner ce mécanisme de commande; ce mécanisme de commande générant une force d'entraînement pour l'agrafe dans un os, un canon (10) fixé à la poignée (4); un dispositif de guidage (12) d'agrafe pour contenir une agrafe (14) à éjecter, et une cheville d'éjection (16) actionnée par le mécanisme de commande, mobile dans ce canon (10) pour éjecter cette agrafe (14) hors et au travers du dispositif de guidage (12) d'agrafe; caractérisé en ce que cette force de commande est suffisante pour entièrement implanter l'agrafe (14) dans un os et sous la surface de l'os sans perforer au préalable un orifice dans l'os; et cette extrémité du dispositif de guidage (12) de l'agrafe est formé d'un creux (22a) sur sa surface interne pour recevoir un fil de suture (20) fixé à l'agrafe (14).

2. Le dispositif d'agrafage selon la revendication 1 dans lequel ce mécanisme de commande est une commande pneumatique et cette poignée (4) comprend une connexion (6) pour connecter à celle-ci un tube à air (8) fournissant de l'air pressurisé au dispositif.

3. Le dispositif d'agrafage selon la revendication 1 caractérisé en ce que la surface interne de cette extrémité du dispositif de guidage (12) de l'agrafe est formée de deux creux (22a) de part et d'autre de celui-ci chacun étant dimensionné pour recevoir une partie du fil de suture (20) fixé à l'agrafe (14) et éjecté avec celle-ci.

4. Le dispositif de guidage selon l'une quelconque des revendications 1-3, caractérisé en ce que le dispositif comprend deux canons (310a, 310b) et deux dispositifs de guidage (312a, 312b) d'agrafe disposés parallèlement l'un par rapport à l'autre et fixés à une poignée commune (304) chacun de ces canons (310a, 310b) comprenant une cheville d'éjection (316a, 316b) pour éjecter une agrafe (314a, 314b) depuis son dispositif de guidage respectif (312a, 312b), cette poignée (304) comprenant une commande pour actionner ces deux chevilles d'éjection (316a, 316b).

5. Le dispositif d'agrafage selon la revendication 1 caractérisé en ce que ce canon (10) est flexible.

6. Le dispositif d'agrafage selon la revendication 1 caractérisé en ce que ce creux (22a) comprend une fente (22) s'étendant axialement.

7. Le dispositif d'agrafage selon la revendication 1 caractérisé en ce que ce creux (22a) comprend une paire de fentes opposées s'étendant axialement pour recevoir une partie du fil de suture (20).

8. Le dispositif d'agrafage selon la revendication 1 caractérisé en ce que ce creux (22a) s'étend jusqu'à la surface externe de ce canon.

9. Le dispositif d'agrafage selon la revendication 4, caractérisé en ce que ces chevilles d'éjection (316a, 316b) sont actionnées par une seule gâchette (318).

10. Le dispositif d'agrafage selon la revendication 4, caractérisé en ce que cette gâchette unique (318) commande les deux chevilles d'éjection (316a, 316b) simultanément.

11. Un dispositif consistant en un dispositif d'agrafage selon l'une quelconque des revendications 1-10 en combinaison avec l'agrafe (14) comprenant un fil de suture (20) fixé à celle-ci.

12. Le dispositif selon la revendication 11, caractérisé en ce que cette agrafe (14) est formée à partir d'une matière élastique qui change de forme lorsqu'elle n'est plus maintenue par le dispositif de guidage (12).

13. Le dispositif selon la revendication 11, caractérisé en ce que l'agrafe (14) comprend une pointe avant et une extrémité commandée pour recevoir la force d'implantation pour implanter cette agrafe (14) dans l'os d'un patient, cette agrafe (14) ayant un axe longitudinal qui passe au travers de ce sommet et cette extrémité de commande, cet axe longitudinal changeant de forme après l'implantation de cette agrafe (14) dans un os.

14. Le dispositif selon la revendication 11, caractérisé en ce que ce fil de suture (20) est fixé au travers d'un orifice (14b) dans cette agrafe (14).

15. Le dispositif selon la revendication 14, caractérisé en ce que cet orifice (14b) est disposé entre cette pointe et cette extrémité commandée.

16. Le dispositif selon la revendication 13, caractérisé en ce que cette agrafe (514) comprend en outre des ébarbures (515) qui se projettent vers l'extérieur à partir de cette extrémité commandée lorsque cette agrafe est éjectée dans un os.

17. Le dispositif selon la revendication 13, caractérisé en comprenant en outre un alésage plié dans cette agrafe (14) qui maintient par friction ce fil de suture (20) durant l'implantation de cette agrafe (14) dans l'os.

18. Le dispositif selon la revendication 17, caractérisé en ce que cet alésage plié s'étend selon un angle par rapport à cet axe longitudinal.

19. Le dispositif selon la revendication 13, caractérisé

en ce que cette extrémité commandée de cette agrafe (14) est sensiblement plate avant l'implantation dans l'os.

20. Le dispositif selon la revendication 13, caractérisé en ce que cette agrafe est formée par un fil métallique plié en une forme de U avec ce fil de suture maintenu dans l'anse de l'agrafe.

21. Le dispositif selon la revendication 13, caractérisé en ce que cette agrafe est au départ sensiblement plate et après implantation dans l'os d'un patient change en une forme ayant une extrémité de commande fendue en forme de queue.

22. Le dispositif selon la revendication 13, dans lequel l'agrafe (14) est formée d'un orifice de part en part (14b) et ce fil de suture (20) est fixé à l'agrafe (14) en passant au travers de cet orifice (14b).

23. Le dispositif selon la revendication 13, dans lequel cette agrafe (14) est réalisée en une matière élastique et est réalisée en une forme courbe, est temporairement déformée en une forme droite au moment où elle est éjectée, et retourne à sa forme courbe après éjection.

24. Le dispositif selon la revendication 13, dans lequel l'agrafe (514) est formée d'une pluralité d'ébarbures (515) se projetant à partir de sa surface externe.

25. Le dispositif selon la revendication 13, caractérisé en ce que cette cheville d'éjection (16) a une extrémité frontale pour venir en contact avec l'agrafe (14) et cette cheville d'éjection (16) est en contact avec l'agrafe sans que cette extrémité frontale ne vienne en contact avec le fil de suture (20).

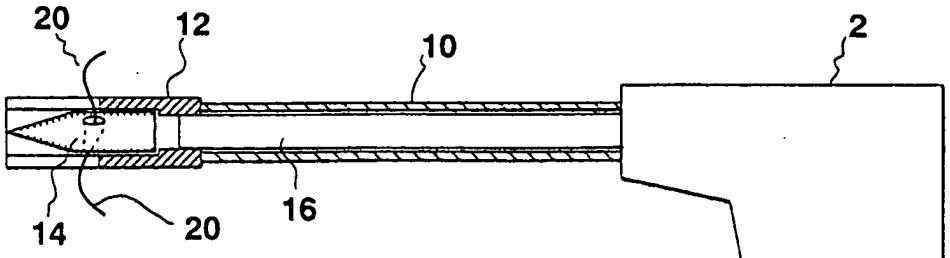


FIG . 1

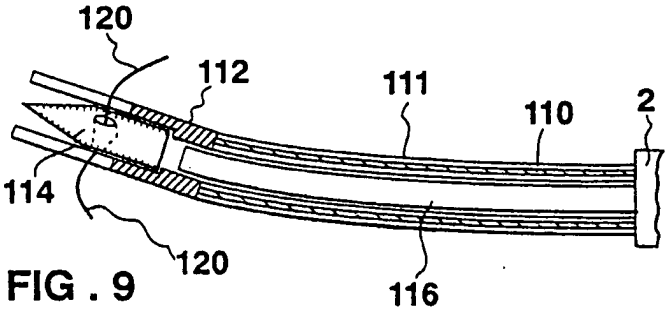


FIG . 9

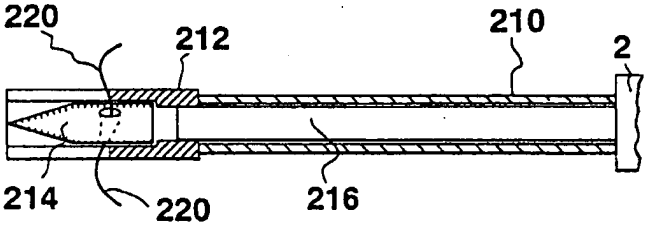


FIG . 10

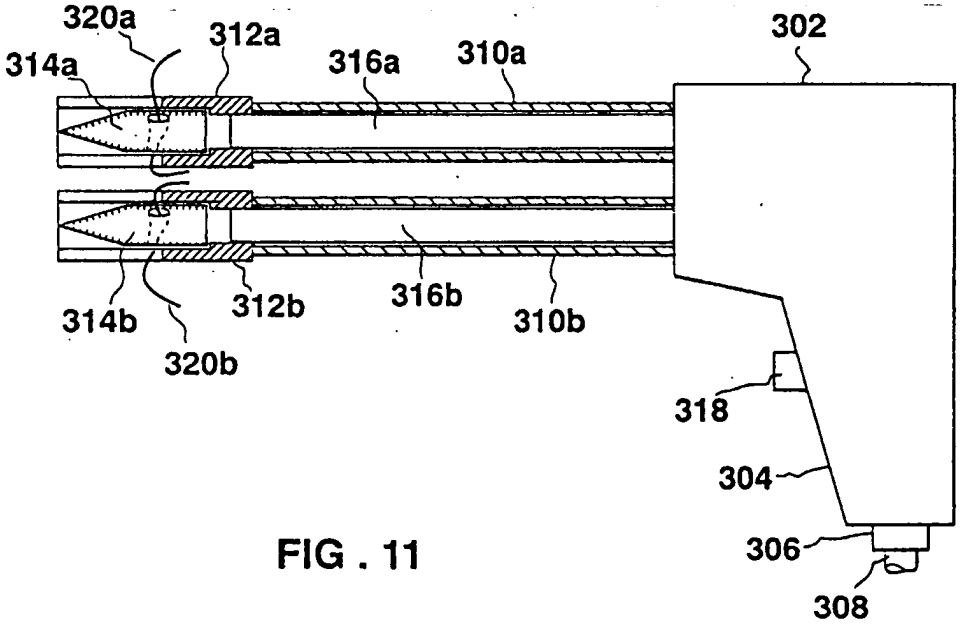


FIG . 11

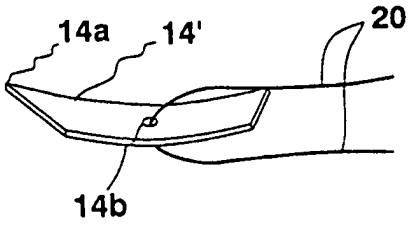


FIG . 2

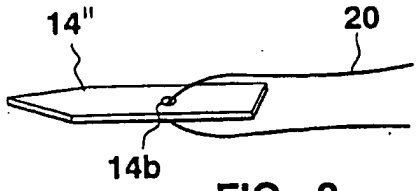


FIG . 3

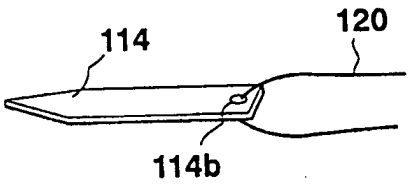


FIG . 12

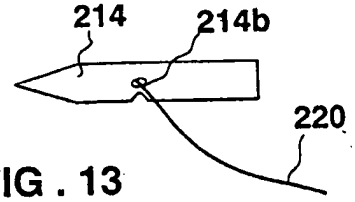


FIG . 13

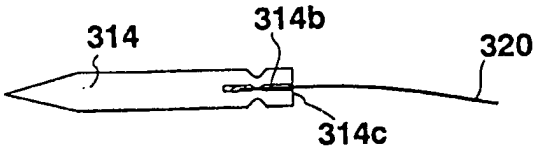


FIG . 14

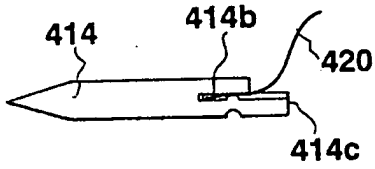


FIG . 15

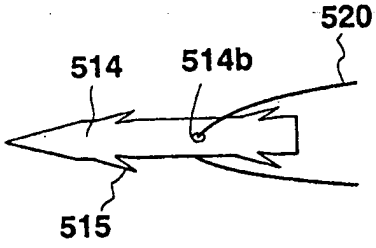


FIG . 16

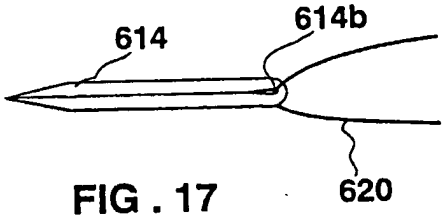


FIG . 17

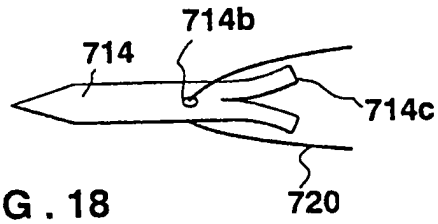


FIG . 18

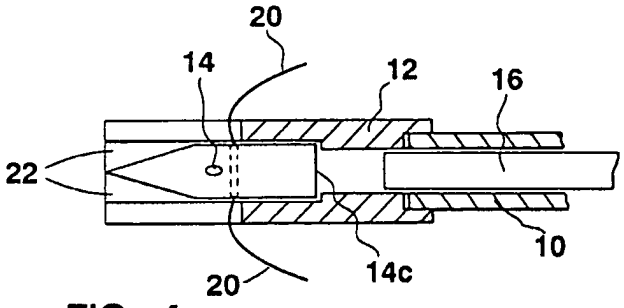


FIG . 4

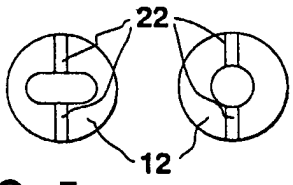


FIG . 5a FIG . 5b

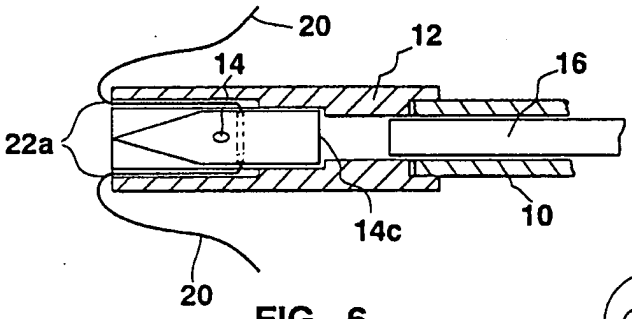


FIG . 6

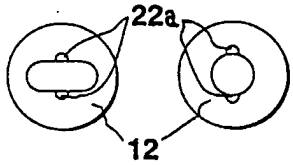
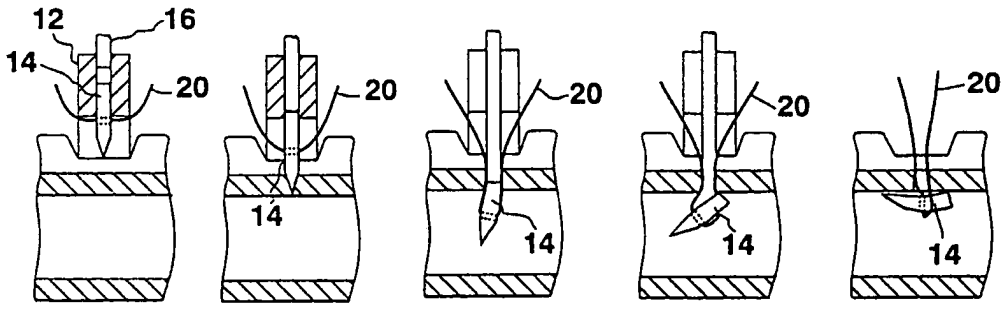


FIG . 7a. FIG . 7b



a b c d e

FIG . 8